

CLAIMS

- 1 1. A network device to identify a non-adaptive flow, comprising:
- 2 a processor executing first instructions to drop packets on a random basis using
- 3 a RED algorithm;
- 4 a classifier to read indicia of a selected flow from at least one field of a header
- 5 of a packet received by said device;
- 6 a processor executing second instructions to calculate a drop interval for packets
- 7 of said selected flow dropped by said RED algorithm, in response to a time at which
- 8 said packets were dropped; and,
- 9 a processor executing third instructions to apply a statistical test to drop
- 10 intervals of a plurality of flows in order to identify said non-adaptive flow.
- 1 2. The apparatus of claim 1 wherein said processor executing said second instructions
- 2 to calculate a drop interval for packets of said selected flow dropped by said RED
- 3 algorithm further comprise:
- 4 said processor executing said second instructions to calculate said drop interval by
- 5 subtracting from a first time at which the most recently received packet was dropped, a
- 6 second time at which an earlier dropped packet was dropped
- 1 3. The apparatus of claim 1 wherein said processor executing third instructions to
- 2 apply a statistical test, further comprises:

3 a processor executing fourth instructions to calculate a median drop interval for
4 said selected flow, said median drop interval having one half of the drop intervals
5 larger than said median and having one half of the drop intervals less than said median;
6 and,

7 a processor executing fifth instructions to compute a statistical difference by
8 subtracting 0.693 times said average drop interval from said median drop interval, and
9 in the event that said statistical difference exceeds a selected threshold, identifying said
10 selected flow as a non-adaptive flow.

1 4. The apparatus as in claim 3 further comprising:

2 a processor executing sixth instructions to compute a "departure from
3 exponential mean" (DEM) value, said DEM value computed by subtracting from
4 said 0.693 times said average drop interval, said median drop interval; and,

5 a processor executing seventh instructions to compare said DEM value with the
6 number 0.5, and in the event that the DEM value is within a preselected range of 0.5,
7 to identify said flow as non-adaptive.

1 5. The apparatus as in claim 4 wherein said preselected range is between 0.45 and any
2 number larger than 0.5.

1 6. The apparatus as in claim 4 further comprising:

2 a processor executing eighth instructions to select said preselected range
3 dynamically in response to DEM values of selected flows.

1 7. The apparatus as in claim 6 further comprising:

2 a processor executing ninth instructions to select said selected flows as a subset
3 of all flows, said subset having selected values of DEM less than a largest value of
4 DEM computed in a set of flows.

1 8. The apparatus as in claim 1 wherein said network device is a router.

1 9. The apparatus as in claim 1 wherein said network device is a switch.

1 10. A method of operating a network device, comprising:

2 dropping packets on a random basis using a RED algorithm;
3 reading indicia of a selected flow from at least one field of a header of a packet
4 received by said device;
5 calculating a drop interval for packets of said selected flow dropped by said
6 RED algorithm, in response to a time at which said packets were dropped; and,
7 applying a statistical test to drop intervals of a plurality of flows in order to
8 identify said non-adaptive flow.

1 11. The method of claim 10 further comprising:

2 calculating said drop interval by subtracting from a first time at which the most
3 recently received packet was dropped, a second time at which an earlier dropped packet
4 was dropped.

1 12. The method of claim 10 further comprising:

2 calculating a median drop interval for said selected flow, said median drop
3 interval having one half of the drop intervals larger than said median and having one
4 half of the drop intervals less than said median; and,

5 computing a statistical difference by subtracting 0.693 times said average drop
6 interval from said median drop interval, and in the event that said statistical difference
7 exceeds a selected threshold, identifying said selected flow as a non-adaptive flow.

1 13. The method of claim 10 further comprising:

2 computing a "departure from exponential mean" (DEM) value, said DEM value
3 computed by subtracting from said 0.693 times said average drop interval, said median
4 drop interval; and,

5 comparing said DEM value with the number 0.5, and in the event that the DEM
6 value is within a preselected range of 0.5, to identify said flow as non-adaptive.

1 14. The method of claim 10 further comprising:

2 selecting said preselected range between 0.45 and any number larger than 0.5.

1 15. The method as in claim 13 further comprising:

2 selecting said preselected range dynamically in response to DEM values of
3 selected flows.

1 16. The apparatus as in claim 14 further comprising:

2 selecting said selected flows as a subset of all flows, said subset having selected
3 values of DEM less than a largest value of DEM computed in a set of flows.

1 17. The method of claim 10 further comprising: executing said method in a router.

1 18. The method of claim 10 further comprising: executing said method in a switch.

1 19. A computer readable media having written thereon instructions for practicing the
2 method of claim 10.

1 20. Signals transmitted over a computer network having encoded therein instructions
2 for practicing the method of claim 10.